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00401892.5 **30 June 2000 (30.06.2000) EP**

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(72) Inventors; and

(75) Inventors/Applicants (for US only): **FELTS, Boris** [FR/NL]; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). **PESQUET-POPESCU, Beatrice** [FR/NL]; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). **BOTTREAU, Vincent** [FR/NL]; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

(74) Agent: **LANDOUSY, Christian**; Internationaal Octrooibureau B.V., Prof Holstlaan 6, NL-5656 AA Eindhoven (NL).

(81) Designated States (national): **CN, JP, KR, US.**

(84) Designated States (regional): European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).

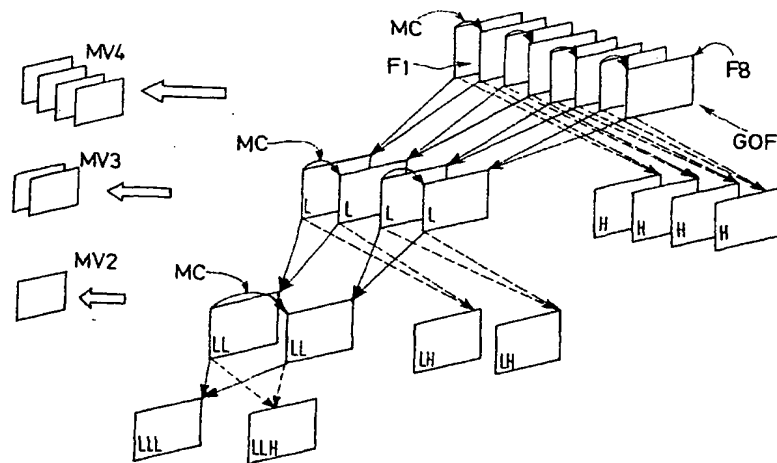
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(88) Date of publication of the international search report:
1 August 2002

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **ENCODING METHOD FOR THE COMPRESSION OF A VIDEO SEQUENCE**



(57) Abstract: The invention relates to an encoding method for the compression of a video sequence. Said method, using a three-dimensional wavelet transform, is based on a hierarchical subband coding process in which the subbands to be encoded are scanned in an order that preserves the initial subband structure of the 3D wavelet transform. According to the invention, a temporal (resp. spatial) scalability is obtained by performing a motion estimation at each temporal resolution level (resp. at the highest spatial resolution level), and only the part of the estimated motion vectors necessary to reconstruct any given temporal (resp. spatial) resolution level is then encoded and put in the bitstream together with the bits encoding the wavelet coefficients at this given temporal (resp. spatial) level, said insertion in the bitstream being done before encoding texture coefficients at the same temporal (resp. spatial) level. Such a solution avoids to encode and send all the motion vector fields in the bitstream, which would be a drawback when a low bitrate is targeted and the receiver only wants a reduced frame rate or spatial resolution.

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 01/07096

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N7/26 H04N7/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CAMPISI P ET AL: "A wavelet transform based videoconferencing system with spatio-temporal scalability" WAVELET APPLICATIONS IN SIGNAL AND IMAGE PROCESSING VII, DENVER, CO, USA, 19-23 JULY 1999, vol. 3813, pages 850-860, XP008001348 Proceedings of the SPIE - The International Society for Optical Engineering, 1999, SPIE-Int. Soc. Opt. Eng, USA ISSN: 0277-786X page 851, paragraph II page 854, paragraph III page 857, paragraph IV figures 2,4,6 --- -/--	1

☒ Further documents are listed in the continuation of box C.

☐ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

14 March 2002

Date of mailing of the international search report

12. 06. 2002

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
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Lombardi, G

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 01/07096

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	ISO/IEC AD HOC GROUP ON MPEG-4 VIDEO VM EDITING: "MPEG-4 Video Verification Model Version 8.0 ISO/IEC JTC1/SC29/WG11 MPEG97/N1796" ISO/IEC JTC1/SC29/WG11 MPEG97/N1796, July 1997 (1997-07), pages 1-283, XP002177337 page 179, paragraph 6 ---	1
A	W. A. PEARLMAN, B.-J. KIM, AND Z. XIONG: "Embedded Video Subband Coding with 3D Spiht" IN P. N. TOPIWALA (ED.), "WAVELET IMAGE AND VIDEO COMPRESSION", 1998, pages 397-432, XP002193121 Kluwer Acad. Publ., Boston page 400, paragraph 2.2 page 404, paragraph 4.1 page 408, paragraph 4.3 page 413, paragraph 5.3 page 414, paragraph 6 figures 2,5,8,9 ---	1
A	CHOI S-J ET AL: "MOTION-COMPENSATED 3-D SUBBAND CODING OF VIDEO" IEEE TRANSACTIONS ON IMAGE PROCESSING, IEEE INC. NEW YORK, US, vol. 8, no. 2, February 1999 (1999-02), pages 155-167, XP000831916 ISSN: 1057-7149 page 157, paragraph III; figures 3,4 page 164, right-hand column, paragraph TYPOGRAPHIC.5 -page 165, left-hand column, paragraph TYPOGRAPHIC.2 -----	1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP 01/07096

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claim : 1

Method of insertion into the bitstream of the motion vectors estimated at each temporal resolution level in the framework of a 3D wavelet transform encoding method with motion compensation.

2. Claim : 2

Method of evaluating the motion vectors at each spatial resolution level, from the motion vectors estimated at the highest resolution level, and of progressively encoding them into the bitstream in the framework of a 3D wavelet transform encoding method with motion compensation.

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- (71) Applicant (*for all designated States except US*): **KONINKLIJKE PHILIPS ELECTRONICS N.V.** [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).
- Published:
— *without international search report and to be republished upon receipt of that report*
- (72) Inventors; and
- (75) Inventors/Applicants (*for US only*): **FELTS, Boris** [FR/NL]; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). **PESQUET-POPESCU, Beatrice** [FR/NL]; Prof.

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(54) Title: ENCODING METHOD FOR THE COMPRESSION OF A VIDEO SEQUENCE

(57) Abstract: The invention relates to an encoding method for the compression of a video sequence. Said method, using a three-dimensional wavelet transform, is based on a hierarchical subband coding process in which the subbands to be encoded are scanned in an order that preserves the initial subband structure of the 3D wavelet transform. According to the invention, a temporal (resp. spatial) scalability is obtained by performing a motion estimation at each temporal resolution level (resp. at the highest spatial resolution level), and only the part of the estimated motion vectors necessary to reconstruct any given temporal (resp. spatial) resolution level is then encoded and put in the bitstream together with the bits encoding the wavelet coefficients at this given temporal (resp. spatial) level, said insertion in the bitstream being done before encoding texture coefficients at the same temporal (resp. spatial) level. Such a solution avoids to encode and send all the motion vector fields in the bitstream, which would be a drawback when a low bitrate is targeted and the receiver only wants a reduced frame rate or spatial resolution.



WO 02/01881 A2

Encoding method for the compression of a video sequence

The present invention relates to an encoding method for the compression of a video sequence divided into groups of frames and decomposed by means of a three-dimensional (3D) wavelet transform leading to a given number of successive resolution levels that correspond to the decomposition levels of said transform, said method being based on a hierarchical subband encoding process leading from the original set of picture elements (pixels) of each group of frames to transform coefficients constituting a hierarchical pyramid, a spatio-temporal orientation tree - in which the roots are formed with the pixels of the approximation subband resulting from the 3D wavelet transform and the offspring of each of these pixels is formed with the pixels of the higher subbands corresponding to the image volume defined by these root pixels - defining the spatio-temporal relationship inside said hierarchical pyramid, the subbands to be encoded being scanned one after the other in an order that respects the parent-offspring dependencies formed in said tree and preserves the initial subband structure of the 3D wavelet transform.

The video streaming over heterogeneous networks requires a high scalability capability. That means that parts of a bitstream can be decoded without a complete decoding of the sequence and can be combined to reconstruct the initial video information at lower spatial or temporal resolutions (spatial/temporal scalability) or with a lower quality (PSNR scalability). A convenient way to achieve all the three types of scalability is a three-dimensional (3D) wavelet decomposition of the motion compensated video sequence.

In a previous European patent application filed by the Applicant on May 3, 2000, with the number 00401216.7 (PHFR000044), a simple method of texture coding having this property has been described. In that method, as well as in other published documents (such as for instance, in "An embedded wavelet video coder using three-dimensional set partitioning in hierarchical trees (SPIHT)", by B. Kim and W.A. Pearlman, Proceedings DCC'97, Data Compression Conference, Snowbird, UT, USA, 25-27 March 1997, pp.251-260), all the motion vector fields are encoded and sent in the bitstream, which may become a major drawback when a low bitrate is targeted and the receiver only wants a reduced frame rate or spatial resolution.

It is therefore an object of the invention to propose an encoding method more adapted to the situation where a high scalability must be obtained.

To this end, the invention relates to an encoding method such as defined in the introductory part of the description and which is moreover characterized in that, in view of a temporal scalability, a motion estimation is performed at each temporal resolution level, the beginning of which is indicated by flags inserted into the bitstream, and only the estimated motion vectors necessary to reconstruct any given temporal resolution level are encoded and put in the bitstream together with the bits encoding the wavelet coefficients at this given temporal level, said motion vectors being inserted into said bitstream before encoding texture coefficients at the same temporal level.

In another embodiment, the invention also relates to an encoding method such as defined in said introductory part and which is characterized in that, in view of a spatial scalability, a motion estimation is performed at the highest spatial resolution level, the vectors thus obtained being divided by two in order to obtain the motion vectors for the lower spatial resolutions, and only the estimated motion vectors necessary to reconstruct any spatial resolution level are encoded and put in the bitstream together with the bits encoding the wavelet coefficients at this given spatial level, said motion vectors being inserted into said bitstream before encoding texture coefficients at the same spatial level, and said encoding operation being carried out on the motion vectors at the lowest spatial resolution, only refinement bits at each spatial resolution being then put in the bitstream bitplane by bitplane, from one resolution level to the other.

The technical solution thus proposed allows to encode only the motion vectors corresponding to the desired frame rate or spatial resolution, instead of sending all the motion vectors corresponding to all possible frame rates and all spatial resolution levels.

The present invention will now be described, by way of example, with reference to the accompanying drawings in which :

Fig.1 illustrates a temporal subband decomposition of the video information with motion compensation using the Haar multiresolution analysis ;

Fig.2 shows the spatio-temporal subbands resulting from a three-dimensional wavelet decomposition ;

Fig.3 illustrates the motion vector insertion in the bitstream for temporal scalability ;

Fig.4 shows the structure of the bitstream obtained with a temporally driven scanning of the spatio-temporal tree ;

Fig.5 is a binary representation of a motion vector and its progressive transmission from the lowest resolution to the highest ;

Fig.6 shows the bitstream organization for motion vector coding in the proposed scalable approach.

A temporal subband decomposition of a video sequence is shown in Fig.1. The illustrated 3D wavelet decomposition with motion compensation is applied to a group of frames (GOF), referenced F1 to F8. In this 3D subband decomposition scheme, each GOF of the input video is first motion-compensated (MC in Fig.1) (this step allows to process sequences with large motion) and then temporally filtered using Haar wavelets (the dotted arrows correspond to a high-pass temporal filtering, while the other ones correspond to a low-pass temporal filtering) and after these two operations, each temporal subband is spatially decomposed into a spatio-temporal subband, which leads to a 3D wavelet representation of the original GOF, as illustrated in Fig.2. In Fig.1, three stages of decomposition are shown (L and H = first stage ; LL and LH = second stage ; LLL and LLH = third stage). At each temporal decomposition level of the illustrated group of 8 frames, a group of motion vector fields is generated (MV4 at the first level, MV3 at the second one, MV2 at the third one). When a Haar multiresolution analysis is used for the temporal decomposition, since one motion vector field is generated between every two frames in the considered group of frames at each temporal decomposition level, the number of motion vector fields is equal to half the number of frames in the temporal subband, i.e. four at the first level of motion vector fields, two at the second one, and one at the third one. At the decoder side, in order to reconstruct a given temporal level, only the motion vector fields at that level and at the lower temporal resolutions (reduced frame rate) are needed.

(A) Temporal scalability

This observation leads, according to the invention, to organize the bitstream in a way that allows a progressive decoding, as described for example in Fig. 3 : three temporal decomposition levels TDL (as shown in Fig.1) yield four temporal resolution levels (1 to 4), which represent the possible frame rates that can be obtained from the initial frame rate. The coefficients corresponding to the lowest resolution temporal level are first encoded, without sending motion vectors at this level, and, for all the other reconstruction frame rates, the motion vector fields and the frames of the corresponding high frequency temporal subband

are encoded. This description of the bitstream organization up to now only takes into account the temporal levels. However, for a complete scalability, one has to consider the spatial scalability inside each temporal level. The solution for wavelet coefficients was described in the European patent application already cited, and it is reminded in Fig. 4 : inside each temporal scale, all the spatial resolutions are successively scanned (SDL = spatial decomposition levels), and therefore all the spatial frequencies are available (frame rates $t = 1$ to 4 ; display sizes $s = 1$ to 4). The upper flags separate two bitplanes, and the lower ones two temporal decomposition levels.

(B) Spatial scalability

In order to be able to reconstruct a reduced spatial resolution video, it is not desirable to transmit at the beginning of the bitstream the motion vector fields of full resolution. Indeed, it is necessary to adapt the motion described by the motion vectors to the size of the current spatial level. Ideally, it would be desirable to have first a low resolution motion vector field corresponding to the lowest spatial resolution and then to be able to progressively increase the resolution of the motion vectors according to the increase in the spatial resolution. Only the difference from a motion vector field resolution to another one would be encoded and transmitted.

It will be assumed that the motion estimation is performed by means of a block-based method like full search block matching or any other derived solution, with an integer pixel precision on full resolution frames (this hypothesis does not reduce the generality of the problem : if one wants to work with half-pixel precision for motion vectors, by multiplying by 2 all the motion vectors at the beginning, one returns in the previous case of integer vectors, even though they will represent fractional displacements). Thus, motion vectors are represented by integers. Given the full resolution motion vector field, in order to satisfy the above requirements of spatial scalability, the motion vector resolution is reduced by a simple divide-by-2 operation. Indeed, as the spatial resolution of the approximation subband is reduced by a factor 2, while the motion is the same as in the full resolution subband, the displacements will be reduced by a factor 2. This division is implemented for integers by a simple shift.

The size of the blocks in the motion estimation must be chosen carefully : indeed, if the original size of the block is 8×8 in the full resolution, it will become 4×4 in the half resolution, then 2×2 in the quarter, and so on. A problem will therefore appear if the original size of the blocks is too small : the size can be null for small spatial resolutions. Thus

it must be checked that the original size is compatible with the number of decomposition/reconstruction levels.

It is now assumed that one has S spatial decomposition levels and that one wants the motion vectors corresponding to all possible resolutions, from the lowest to the highest. Then, either the initial motion vectors are divided by 2^S or a shift of S positions is performed. The result represents the motion vectors corresponding to the blocks from lowest resolution whom the size is divided by 2^S . A division by 2^{S-1} of the original motion vector would provide the next spatial resolution. But this value is already available from the previous operation. Indeed, it corresponds to a shift of $S - 1$ positions. The difference from the first operation is the bit in the binary representation of the motion vector with a weight of 2^{S-1} . It is then sufficient to add this bit (the refinement bit) to the previously transmitted vector to reconstruct the motion vector at a higher resolution, which is illustrated in Fig. 5 for $S = 4$. This progressive transmission of the motion vectors allows to include in the bitstream the refinement bits of the motion vector fields from one spatial resolution to another just before the bits corresponding to the texture at the same spatial level. The proposed method is resumed in Fig. 6.

The motion vectors at the lowest resolution are encoded with a DPCM technique followed by entropy coding using usual VLC tables (e.g., those used in MPEG-4). For the other resolution levels, a complete bitplane composed of the refinement bits of the motion vector field has to be encoded, for instance by means of a contextual arithmetic encoding, with the context depending on the horizontal or vertical component of the motion vector.

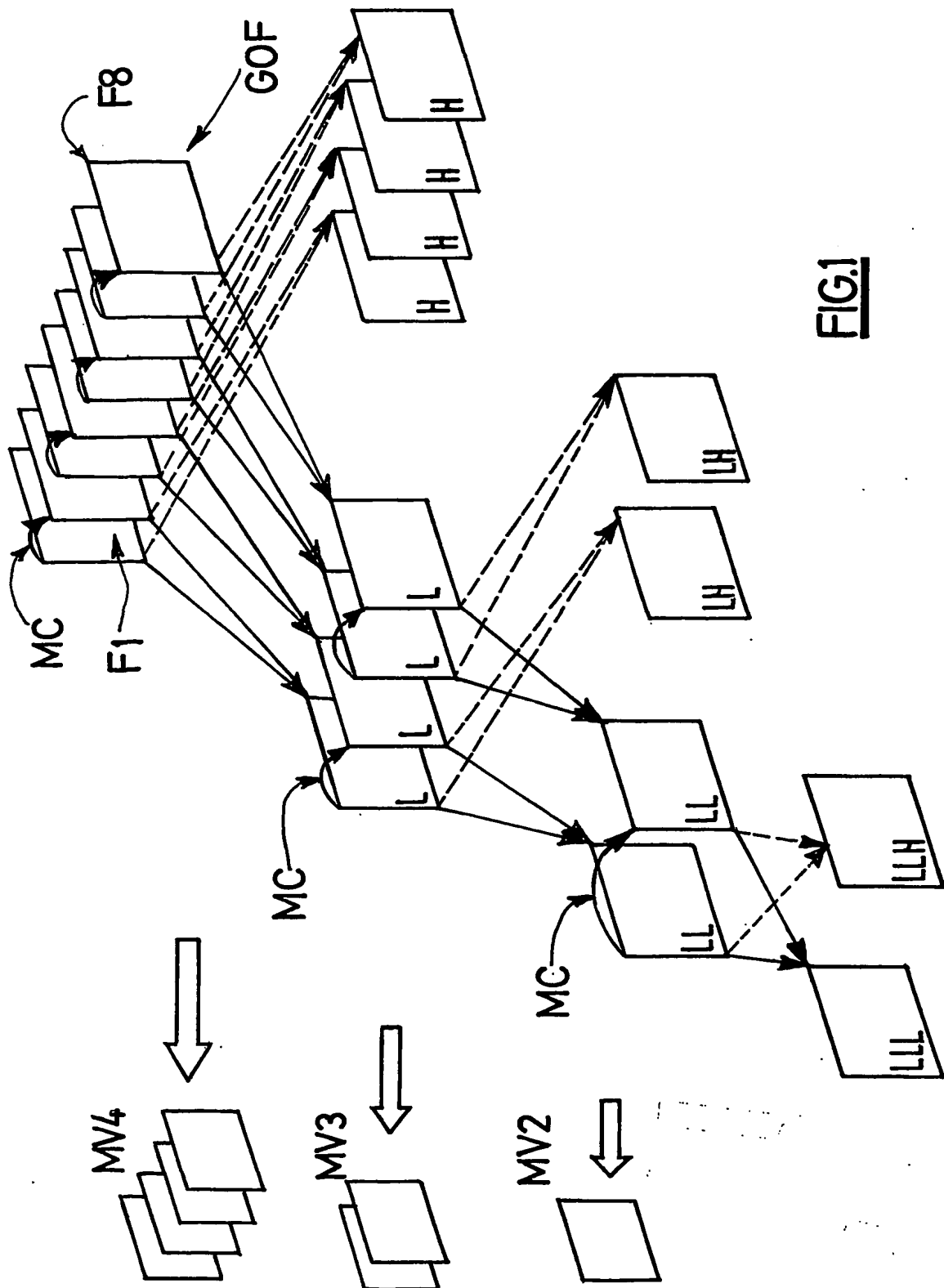
The part of the bitstream representing motion vectors precedes any information concerning the texture. The difference with respect to a "classical" non-scalable approach is that the hierarchy of temporal and spatial levels is transposed to the motion vector coding. The most significant improvement with respect to the previous technique is that the motion information can be decoded progressively. For a given spatial resolution, the decoder does not have to decode parts of the bitstream that are not useful at that level.

CLAIMS:

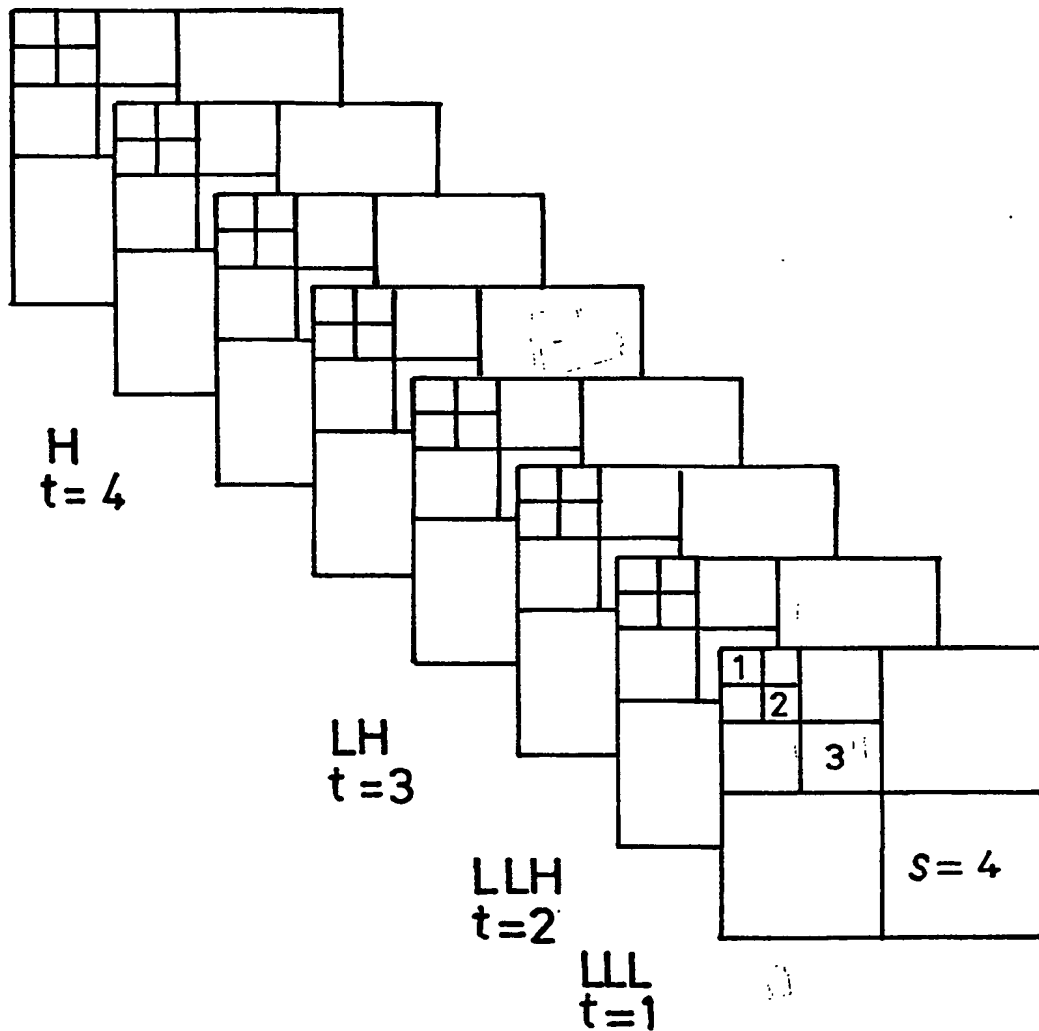
1. An encoding method for the compression of a video sequence divided into groups of frames and decomposed by means of a three-dimensional (3D) wavelet transform leading to a given number of successive resolution levels that correspond to the decomposition levels of said transform, said method being based on a hierarchical subband encoding process leading from the original set of picture elements (pixels) of each group of frames to transform coefficients constituting a hierarchical pyramid, a spatio-temporal orientation tree - in which the roots are formed with the pixels of the approximation subband resulting from the 3D wavelet transform and the offspring of each of these pixels is formed with the pixels of the higher subbands corresponding to the image volume defined by these root pixels - defining the spatio-temporal relationship inside said hierarchical pyramid, the subbands to be encoded being scanned one after the other in an order that respects the parent-offspring dependencies formed in said tree and preserves the initial subband structure of the 3D wavelet transform, said method being further characterized in that, in view of a temporal scalability, a motion estimation is performed at each temporal resolution level, the beginning of which is indicated by flags inserted into the bitstream, and only the estimated motion vectors necessary to reconstruct any given temporal resolution level are encoded and put in the bitstream together with the bits encoding the wavelet coefficients at this given temporal level, said motion vectors being inserted into said bitstream before encoding texture coefficients at the same temporal level.

2. An encoding method for the compression of a video sequence divided into groups of frames and decomposed by means of a three-dimensional (3D) wavelet transform leading to a given number of successive resolution levels that correspond to the decomposition levels of said transform, said method being based on a hierarchical subband encoding process leading from the original set of picture elements (pixels) of each group of frames to transform coefficients constituting a hierarchical pyramid, a spatio-temporal orientation tree - in which the roots are formed with the pixels of the approximation subband resulting from the 3D wavelet transform and the offspring of each of these pixels is formed with the pixels of the higher subbands corresponding to the image volume defined by these

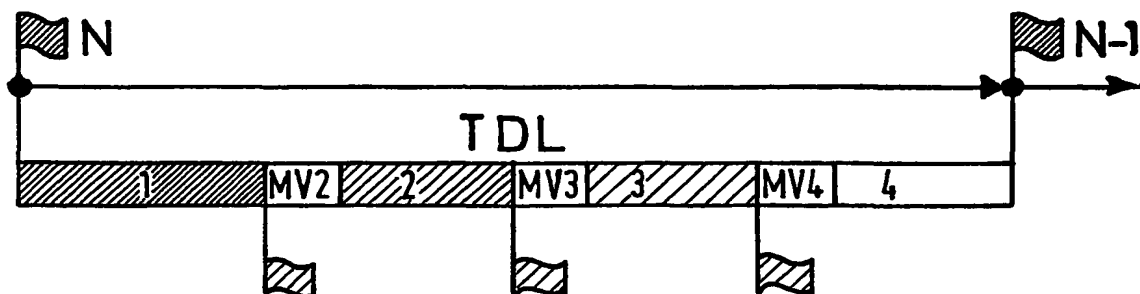
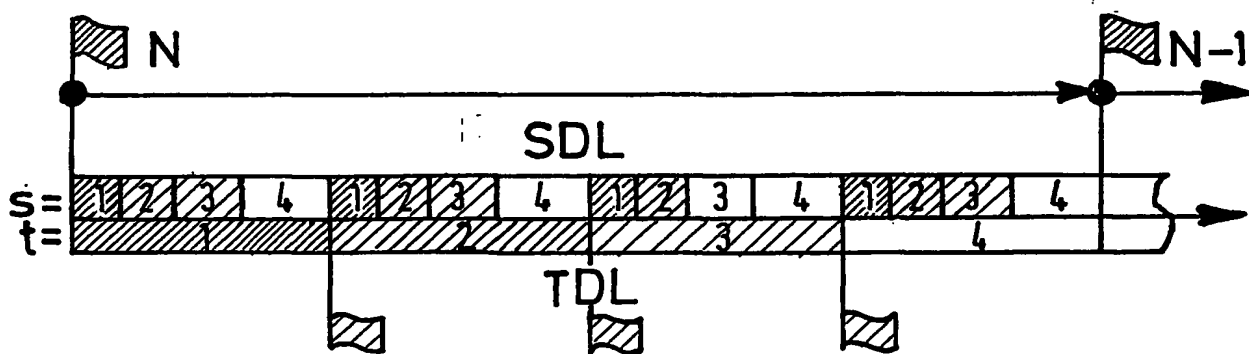
root pixels -defining the spatio-temporal relationship inside said hierarchical pyramid, the subbands to be encoded being scanned one after the other in an order that respects the parent-offspring dependencies formed in said tree and preserves the initial subband structure of the 3D wavelet transform, said method being further characterized in that, in view of a spatial scalability, a motion estimation is performed at the highest spatial resolution level, the vectors thus obtained being divided by two in order to obtain the motion vectors for the lower spatial resolutions, and only the estimated motion vectors necessary to reconstruct any spatial resolution level are encoded and put in the bitstream together with the bits encoding the wavelet coefficients at this given spatial level, said motion vectors being inserted into said bitstream before encoding texture coefficients at the same spatial level, and said encoding operation being carried out on the motion vectors at the lowest spatial resolution, only refinement bits at each spatial resolution being then put in the bitstream bitplane by bitplane, from one resolution level to the other.



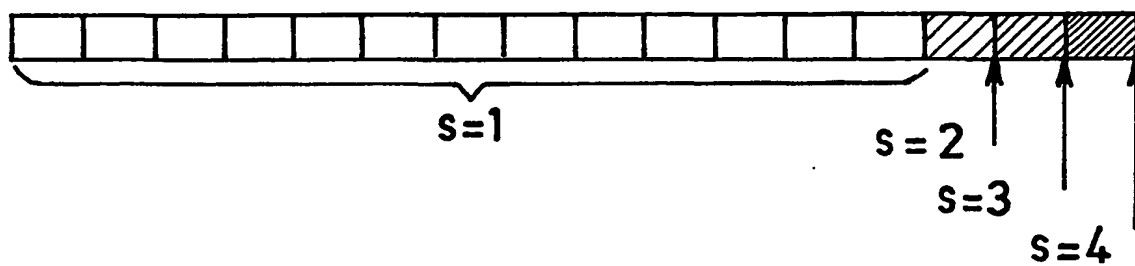
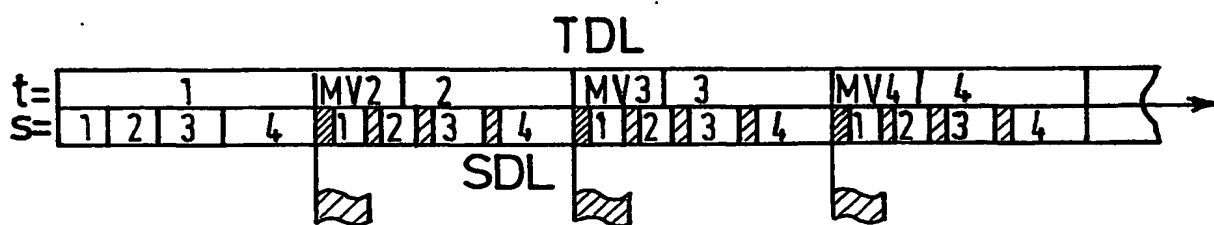
2/4

FIG.2

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FIG.3FIG.4

4/4

FIG.5FIG.6

PATENT COOPERATION TREATY

PCT

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AUG 19 2002

INTERNATIONAL SEARCH REPORT

Technology Center 2600

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference PHFR000070W0	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/EP 01/ 07096	International filing date (day/month/year) 22/06/2001	(Earliest) Priority Date (day/month/year) 30/06/2000
Applicant KONINKLIJKE PHILIPS ELECTRONICS N.V.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 5 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☒ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☐ as suggested by the applicant.

☒ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1

☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP 01/07096

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because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

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1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claim : 1

Method of insertion into the bitstream of the motion vectors estimated at each temporal resolution level in the framework of a 3D wavelet transform encoding method with motion compensation.

2. Claim : 2

Method of evaluating the motion vectors at each spatial resolution level, from the motion vectors estimated at the highest resolution level, and of progressively encoding them into the bitstream in the framework of a 3D wavelet transform encoding method with motion compensation.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 01/07096

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04N7/26 H04N7/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>CAMPISI P ET AL: "A wavelet transform based videoconferencing system with spatio-temporal scalability"</p> <p>WAVELET APPLICATIONS IN SIGNAL AND IMAGE PROCESSING VII, DENVER, CO, USA, 19-23 JULY 1999,</p> <p>vol. 3813, pages 850-860, XP008001348</p> <p>Proceedings of the SPIE - The International Society for Optical Engineering, 1999, SPIE-Int. Soc. Opt. Eng, USA</p> <p>ISSN: 0277-786X</p> <p>page 851, paragraph II</p> <p>page 854, paragraph III</p> <p>page 857, paragraph IV</p> <p>figures 2,4,6</p> <p style="text-align: center;">--- -/--</p>	1



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

14 March 2002

Date of mailing of the international search report

12. 06. 2002

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 01/07096

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	ISO/IEC AD HOC GROUP ON MPEG-4 VIDEO VM EDITING: "MPEG-4 Video Verification Model Version 8.0 ISO/IEC JTC1/SC29/WG11 MPEG97/N1796" ISO/IEC JTC1/SC29/WG11 MPEG97/N1796, July 1997 (1997-07), pages 1-283, XP002177337 page 179, paragraph 6 ---	1
A	W. A. PEARLMAN, B.-J. KIM, AND Z. XIONG: "Embedded Video Subband Coding with 3D Spiht" IN P. N. TOPIWALA (ED.), "WAVELET IMAGE AND VIDEO COMPRESSION", 1998, pages 397-432, XP002193121 Kluwer Acad. Publ., Boston page 400, paragraph 2.2 page 404, paragraph 4.1 page 408, paragraph 4.3 page 413, paragraph 5.3 page 414, paragraph 6 figures 2,5,8,9 ---	1
A	CHOI S-J ET AL: "MOTION-COMPENSATED 3-D SUBBAND CODING OF VIDEO" IEEE TRANSACTIONS ON IMAGE PROCESSING, IEEE INC. NEW YORK, US, vol. 8, no. 2, February 1999 (1999-02), pages 155-167, XP000831916 ISSN: 1057-7149 page 157, paragraph III; figures 3,4 page 164, right-hand column, paragraph TYPOGRAPHIC.5 -page 165, left-hand column, paragraph TYPOGRAPHIC.2 -----	1